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## PARASITISM IN RELATION TO BIRDS.

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(PLATE I.)

PARASITISM is a subject which at the present time is offering a wide field of investigation to biologists, especially so to bacteriologist and parasitologist proper.

Upwards of thirty Protozoa—representing the main division of the group—are known at some stage or other of their life-history to be parasitic in the human body; the presence of which causes diseases of a most vicious nature, such, for example, as “sleeping sickness,” due to *Trypanosoma gambiense*. The so-called Leishman-Donovan body, the parasite of dum-dum fever or splenomegaly, and many others of a similar nature may be cited.

No less important is the parasitism as exhibited by the phyla Platyhelminthes and Nematohelminthes. These phyla show different degrees of parasitism, as will be seen from the following classification:—

Phyla.	Family.	Degree of Parasitism.
Platyhelminthes.	<i>Turbellaria.</i>	All free-living.
	<i>Trematoda.</i>	{ Endo-parasitic.
	<i>Cestoda.</i>	{ Ecto-parasitic. All endo-parasitic.

These families are undoubtedly connected with one another.  
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The Turbellarians are all free-living, with the exception of a few marine forms which have taken to parasitism.

The Trematodes are all parasitic, showing ecto-parasitism as in *Polystomium integerrimum*, and endo-parasitism as in the Liver Fluke (*Distomum hepaticum*).

The Cestodes, on the other hand, are all endo-parasitic.

Taking next the phylum Nematohelminthes, we can tabulate it thus:—

Phylum.	Family.	Degree of Parasitism.
Nematohelminthes.	<i>Nematoda</i> .	Free-living and parasitic forms.
	<i>Nematomorpha</i> .	Also free-living and parasitic forms.
	<i>Acanthocephala</i> .	Solely endo-parasitic.

From the above we see that the *Nematoda* show free living and parasitic forms.

Such is the case also with the *Nematomorpha*. But when we come to the family *Acanthocephala*, it is seen that it has been specially constituted for the justification of a few peculiar genera, of which *Echinorhynchus* is the best known, and whose larvæ live in *arthropod* and the adult in *vertebrate hosts* respectively.

This paper will deal chiefly with the *Cestoda*, *Acanthocephala*, and *Nematoda* which were found in the alimentary canal of some of our common birds.

An attempt has also been made to show the relation, if any, between the *Mallophaga*, or lice, found on the birds and the number of parasites found in the intestines. The large table\* will show the month, locality, food of bird, and position of parasite when found. The life-history of Cestodes in general might here be stated with advantage.

*Life-history*.—Cestodes are exclusively endo-parasitic, i. e., they are found in the tissue or canal of the host upon which they prey. The larval life is lived in the tissues or chambers of *invertebrate* animals; while the adult stage of the Cestode is passed in some *vertebrate* host, with the exception of *Archigetes* sp.

\* A single page only of this table is here printed.



It is thus seen that the *Cestoda* illustrate enteric parasitism with entire loss of alimentary canal. They usually alternate between two hosts, and show a *cestoid* and *cystic* stage, such as, for instance, *Tænia cœnurus*, alternating between Dog (cestoid) and Sheep (cystic).

A general survey of *Cestoda* furnishes the following characters :—

- (1) Elongated flat worms with their cuticle and generally segmented body.
- (2) Head may have hooks and suckers present.
- (3) No mouth or alimentary canal ; food being absorbed osmotically over the whole body-surface.
- (4) Life-history of two phases :—
  - (i) The cystic.
  - (ii) The cestoid.
- (5) No sense-organs.
- (6) One or two longitudinally excretory vessels.
- (7) Reproductive organs discontinuous from one proglottis to the other.
- (8) Endo-parasitic.

Each joint, or proglottis, contains at first male genitalia ; later on the female organs are developed, and ultimately self-fertilization takes place. Thus it is seen that the proglottides near the head, or scolex, contain testes. Next come the ones bearing testes and ovaries, and lastly appear segments bearing only fertilized ova, and thus bearing embryos.

A controversy has here arisen as to whether the Tapeworm is to be considered as a *colony*, and that each segment is a complete animal, or whether the whole number of segments is to be taken as a *single animal*. Steenstrup, and, following his suggestions, Leuckart, Von Siebold, Van Beneden, and others, came to the conclusion that a jointed Tapeworm is really a colony composed of two generations :—

- (1) The head and neck being derived from the larva.
- (2) The segments from the intercalated growth of the neck region thus constituting a second generation.

This colonial view was held from 1851–1880. Recent work has, however, shown that the Cestode, or Tapeworm, is more probably a monozoon.

Hatschek and Lang held the intermediate position.

*Collection and Preservation.*—The Tapeworms of birds are for the most part found in the alimentary canal (sometimes in the mesentery, having perforated the canal-wall). They are found in a fresh bird fixed to the wall of the canal by means of their suckers, or hooks, or both; the rest of the body, or the strobila, lies loosely in the lumen, and is *never very extended*, but generally contracted to a very short dimension, and always lies in the direction of the cloaca, due to the flow of excreta. The position occupied by these parasites in the alimentary canal is shown in the following tables, from which it will be seen that the greater number of parasites was obtained from the ileum or small intestine.

*Method of Procedure.*—The bird to be examined was laid on a dissecting board and the skin cut open from neck to cloaca, and deflected on each side so as to thus expose the pectoral muscles. The pectoral muscles were cut away, and the sternum completely removed.

By doing this the whole of the viscera is exposed *in situ*. Next, the state of the viscera was commented upon in the following table, and any Tapeworms lying in the mesentery were collected :—

Number of Specimen.	Condition of Bird.	State of Viscera.	Number of Tapeworm.
—	Good.	Full.	—
—	Poor.	Putrid.	—
—	Poor.	Shrunken.	—
—	Fair.	Distended.	—

The whole of the alimentary canal was then taken out and pinned out on a wax table under water. Next the canal was laid open by means of a pair of scissors, and the contents examined. This was also done to the cæca (if present).

The large parasites were picked out, if loose, but if still adhering to the canal-wall they were allowed to remain for some ten minutes, when they release their hold and can then be bottled. The larger ones having been thus obtained, the fluid



contents of the alimentary system were poured into a large vessel, and a small quantity of a fixing agent\* added; any small and transparent Tapeworms were by this means caused to become opaque and easily seen.

The Tapeworms obtained were allowed to wash in running water for about two or three hours, during which time they become extended to the full.

*Fixing.*—Next comes the fixing, which is performed by immersion of the worms in some fixing solution for a certain length of time. The fixing solution which acted best was the following:—Five per cent. corrosive sublimate, one per cent. acetic acid, ninety-four per cent. water.

The worms were allowed to remain in this fixing solution for about twenty minutes. Of course, in the case of the large ones more time was allowed.

*Washing.*—They were next transferred to running water to thoroughly wash out the fixing, a time generally extending over about twelve hours.

The next process was to pass the worms through varying grades of alcohol, commencing with sixty per cent. alcohol, then seventy per cent., next eighty per cent., finishing with ninety per cent. The time of immersion in each case being about twice the former; that is, four hours in sixty per cent. alcohol, and eight hours in seventy per cent., sixteen hours in eighty per cent. alcohol.

*Staining.*—From the ninety per cent. alcohol the worms were passed into some suitable staining solution. *Alcoholic borax-carmin*e was found to be most suitable for staining *in toto*; *methyl green* was also used, but not so successfully. After being in the staining solution for about twenty-four hours, the specimens were toned down to the requisite depth of colour by immersion in sixty per cent. alcohol, to which nitric acid had been added—three drops of acid to one hundred cubic cms. of alcohol.

*Dehydratin.*—The stained Tapeworms were then again run through the varying strengths of alcohol, ending up with absolute alcohol to rid them of the water. From the absolute alcohol they were next transferred to xylol as a clearing agent. Oil of cloves was found to make them too brittle for mounting.

\* Two per cent. corrosive sublimate in alcohol.

The specimens were then mounted in Canada balsam and labelled.

The following is a list of birds examined, showing the average number of ecto-parasites and endo-parasites per individual:—

Species of Bird.	Ecto-parasite per individual.	Endo-parasite per individual.
Starling ( <i>Sturnus vulgaris</i> ).....	6·00	1·24
Blackbird ( <i>Turdus merula</i> ).....	18·00	35·10
Rook ( <i>Corvus frugilegus</i> ) .....	160·40	—
Thrush ( <i>Turdus musicus</i> ) .....	12·70	15·00
Robin ( <i>Erithacus rubecula</i> ).....	2·00	0·50
Cuckoo ( <i>Cuculus canorus</i> ) .....	—	1·00
Green Linnet ( <i>Emberiza citrinella</i> ) .....	—	—
Bullfinch ( <i>Pyrrhula europæa</i> ) .....	—	—
Sparrow ( <i>Passer domesticus</i> ) .....	—	—
Kestrel ( <i>Falco tinnunculus</i> ) .....	2 (hundreds of eggs)	—
Peregrine ( <i>Falco peregrinus</i> ) .....	eggs	—
Curlew ( <i>Numenius arquata</i> ) .....	120	49·50
Oystercatcher ( <i>Hæmatopus ostralegus</i> ) ...	20·30	4·20
Kittiwake ( <i>Rissa tridactyla</i> ) .....	9·00	—
Redshank ( <i>Totanus calidris</i> ) .....	—	—
Plover ( <i>Ægialitis hiaticola</i> ) .....	5·5	7·00
Woodpecker ( <i>Dendrocopus minor</i> ).....	—	—
Tit ( <i>Acredula caudata</i> ) .....	—	—
Mudlark ( <i>Anthus obscurus</i> ).....	2·50	1·20
Snipe ( <i>Gallinago cælestis</i> ) .....	1·00	—
Chaffinch ( <i>Fringilla cælebs</i> ) .....	—	—
Lesser Black-backed Gull ( <i>Larus fuscus</i> )	—	2
Herring Gull ( <i>L. argentatus</i> ) .....	—	1
Tawny Owl ( <i>Syrnium aluco</i> ) .....	—	—

Twenty-four different species of birds were thus examined. The blanks are due to the fact that comparatively few birds of that species were examined, and therefore no data of any value could be obtained for the other columns.

From the above table, rough as it is, there seems to be a relation between the number of lice externally and the number of parasites internally, with the exception of the Rook and Hawks, in which no endo-parasites were found, probably due to the abundance of gastric fluid secreted, and which thus limits the possible number of endo-parasites to a very few, namely, those

which are very highly specialized in relation to the environment of very intensified gastric secretion.

*N.B.*—The number of endo-parasites seems to increase with the increase of ecto-parasites, which lends itself to the assumption that the lice may serve as *intermediate hosts* in most species of birds.

It is a well known fact that the greater number of lice are found on the head region, and especially near the mouth, which fact makes it conceivable that the parasite can easily find access into the alimentary canal of the final host (bird) from this possible intermediate host (lice), of which as yet so few have been discovered to the hosts.

The parasites found were Cestodes and Nematodes, and on examining the number of birds investigated, and the number of these parasites found, the proportion of Cestodes to Nematodes proved to be 4·4 Cestodes for every one Nematode; showing that 4·4 times more Cestodes were found than Nematodes. On the other hand, connecting the number with the numbers of birds infested, it was found that:—

Thirty-two per cent. birds infested by Cestodes.

Twenty-five per cent. birds infested by Nematodes.

The following is a table with a classification of parasites found in the different birds:—

Parasite.	Starling.	Thrush.	Blackbird.	L. M. Gull.	Curlew.
<i>Dilepis undula</i> .....	*	*	*		
<i>Cheanotænia parina</i> (?) .....	*				
<i>Monopylidium mus- culosum</i> .....	*				
<i>Anomatænia con- stricta</i> .....		*			
<i>A. nymphaea</i> .....					*

#### Family HYMENOLEPIDIDÆ (Raillet & Henry).

##### *Family Diagnosis.*

##### TENIOIDEA.

- (1) Scolex with an armed rostellum or without.
- (2) Hooks on rostellum, not hammer-shaped.

- (3) Usually unarmed.
- (4) A single, or, rarely, a double set of reproductive organs in each segment.
- (5) Genital pores marginal and bilateral, unilateral, or regularly or irregularly alternate.

Subfamily DIPHYLLINÆ.

- (1) Rostellum armed or rarely absent.
- (2) Suckers unarmed.
- (3) A single set, or, rarely, a double set of reproductive organs in each segment.
- (4) Uterus sac-like, simple or lobulated, or not persistent, breaking down into numerous egg-capsules, each containing one or several eggs.
- (5) Pora-uterine organs not developed, adults in birds, mammals, and reptiles.

The diagnostic character of each genus will now be given also:—

Genus DILEPIS (Weinland, 1858).

(From Cestodes of North American birds, by Ransom.)

*Generic Diagnosis.*

- (1) The rostellum armed with a double crown of hooks, which possess long dorsal but short vertical root and a long blade.
- (2) The inner longitudinal muscle layer consists of numerous bundles.
- (3) Genital pores unilateral.
- (4) Genital canals pass dorsal of the longitudinal excretory vessels and nerves.
- (5) Vas deferens coiled.
- (6) Seminal vesicæ not developed.
- (7) Testicles in medullary portion of segment surrounding the female glands at the sides and behind, typically numerous (40-50), but may be reduced in number to 7.
- (8) Uterus sac-like, with few or numerous out-pocketings. Adults in birds and animals.



## Family HYMENOLEPIDIDÆ, genus MONOPYLIDIUM.

*Generic Diagnosis.*

## DIPHYLLINÆ.

- (1) Rostellum armed with a double or single crown of hooks.
- (2) A single set of reproductive organs in each segment.
- (3) Genital pores irregularly alternate, rarely unilateral.
- (4) Genital canals pass between the longitudinal excretory vessels and dorsal of the longitudinal nerve, or dorsal of both excretory vessels.
- (5) Testicles numerous (20-40 or more) behind the female glands, or also lateral on both sides of the latter.
- (6) Vas deferens coiled; seminal vesicle absent.
- (7) Uterus breaks down into egg-capsules, each containing one or several eggs.

Adults in birds: Starling.

## Family HYMENOLEPIDIDÆ, genus ANOMATÆNIA (Cohn).

*Generic Diagnosis.*

## DIPHYLLINÆ.

- (1) Rostellum with double crown of hooks, with long dorsal and short neutral root and long blade.
- (2) Genital pores irregularly alternate near the anterior margin.
- (3) Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve.
- (4) Vas deferens coiled; seminal vesicle absent.
- (5) Testicles numerous in posterior position of segment.
- (6) Uterus sac-like.

Adults in birds and mammals: Thrush.

Type species:—(1) *Anomatænia constricta* in Thrush; (2) *A. nymphaea* in Curlew.

As will be seen from the above, the Starling is the bird which seems to be infested by the greatest variety of Cestodes.

The number of Cestodes collected was numerous, but the identification became very uncertain, due to the difficulty of making out the precise positions of the genital ducts and genital organs in general, owing to the fact that time did not permit of the microtoming of the segments, which in the majority of cases is essential for identification of the species.

*Nematodes*.—Of the *Nematodes* present the greater number by far belonged to the class *Acanthocephala* of the genus *Echinorhynchus*.

The *Echinorhynchus* larva is found in such intermediate hosts as the following:—(1) Amphipod (*Gammarus pulex*); (2) Isopod (*Ascellus aquaticus*); (3) Beetles, Flaps, &c.; (4) Grubs of Cockchafer.

#### Observation.

From this it is seen that the intermediate host is probably one of the insects contained in the diet of the bird.

The *Echinorhynchus* proportion to the other *Nematodes* found was 4-1; Round Worms to Thorn-headed Worms (*Acanthocephala*) as 1-4.

*Acanthocephala*.—This group embraces a small series of parasites which in general appearance resemble the Nematode Round Worms. They differ, however, essentially in possessing scolices covered with spines.

They are destitute of digestive organs. The species are entozoal in habit, abounding particularly in reptiles and fishes.

The part table (p. 53) serves to show the method of treatment in dissection, an attempt being made to show the contents of stomach and the condition of the bird. The following abbreviations are used:—V. G. C. = Very good condition; G. C. = Good condition; F. C. = Fair condition; P. C. = Poor condition.

#### Summary.

A few words here will not be out of place upon the importance of the relation of the diet of the bird to the bird itself. W. P. Pycraft, in his admirable little book on 'Bird Life,' has a chapter on the "Foods of Birds," in which he comments upon the following points.

The Wrybill Plover has its bill turned sharply to one side to enable it to pick out Crustacea from under the stones. This fact at once confines the Wrybill Plover to a diet of Crustacea for the greater part of its sustenance, and therefore whatever parasites the Wrybill may have will no doubt be connected and related to the diet of Crustacea.

The South American Hoatzin has made its crop do the work

of a gizzard. This hampers it in flight by the extra weight in front, and has even altered the shape of its breast-bone.

In the stomach of the Great Crested Grebe, which lives on fish, we never find stones or pebbles, but only feathers; why so no one has hitherto explained.

Tradition has it that the Snipe and Woodcock live by "suction," consequently they are cooked without the removal of the entrails.

These facts show what a vital relation exists between the food (therefore the method of feeding) and the structure of the bird.

In the same way a vital connection no doubt exists between the food and the parasite infesting the bird. Quoting Robert Newstead's records from the supplement to the 'Journal of the Board of Agriculture' of Dec. 9th, 1908, on the "Food of British Birds," it is seen that from his observations the insects chiefly found in the stomach contents, putting them in order of frequency, are:—

- (1) Weevils (*Rhynchophora*).
- (2) Dung Beetles (*Scarabæidæ*).
- (3) Two-winged flies and their larva (Leather Jackets).

Then comes a scale of others which we will neglect. He ultimately comes to the conclusion that birds on the whole are beneficial to the interests of horticulture and agriculture. Each species of birds, he states, has its own particular diet.

These observations by so able an authority confirm the fact that the probability of finding the solution to the occurrence of particular parasites in particular species of birds lies in the particular diet characteristic of that species.

#### FURTHER OBSERVATIONS.

*Occurrence of Extra Cæca in Birds Examined.*—An examination of the table shows the presence of extra cæca in birds examined. The cæca, in most cases, were granular in composition, and the lumen was very small. They varied from  $\frac{1}{4}$ -inch to  $\frac{3}{4}$ -inch in length, and generally occurred about nine inches above the ordinary cæca. Most of the Mudlarks\* showed extra cæca.

\* Local name for Rock-Pipit (*Anthus obscurus*).

*Abnormalities.* — The abnormalities observed among the number of Tapeworms collected were few. The chief diversions from the normal type were :—(1) Interpolated segments; (2) Perforated segments; (3) Irregularity of the genital organs.

(1) *Interpolated Segments.*—Here the extra segments were triangular in shape and wedged in between two normal segments. No genital organs occurred in these interpolated segments.

(2) *Perforated Segments.*—Three cases of this abnormality were observed. The perforation was clean and not jagged, and showed for about three segments.

(3) *Irregularity of Genital Organs.*—In a Cestode from the Plover some of the segments showed the genital openings to be irregularly disposed, instead of unilateral.

In conclusion, it may be stated that several of the parasites, about fifty, were permanently stained, mounted, and duly labelled.

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- (9) " " " 'Worms.'
- (10) 'Lancet,' 1883-7, 1877, 1868.



Bird.	Locality.	Month.	Food in Stomach.	Ecto-parasite.	Position.	Endo-parasite.	PARASITES. Position in Alimentary Canal.				
							Œsoph.	Duodo.	Ileum.	Cæca.	Rectum.
Starling (male).	Llanfairfechan.	March									
Starling (male).	Bangor.	"	Small shells 5; larvæ and shells; very little herbage.	Mallophaga.	General.	1 Nematode.	—	In distal portion.	None.	None.	
Starling (male).	Bangor.	"	2 grs. oats; No. of hairs; 4 white bodies; 1 larva.	Mallophaga.	Head.	4 Nematodes.	—	One, largest.	Three.	—	
Starling (female).	Bangor.	"	1 beetle; 3 larvæ and shells; large piece of bone.	—	—	—	—	—	—	—	
Starling (male).	Bangor.	"	Numerous beetles; 1 larva and shell; grit.	Mallophaga.	General.	—	—	Contained cyst on outside.	—	—	
Starling (female).	Bangor.	"	Fat undigested.	—	—	—	—	—	—	—	
P. G.	Bangor.	"									
Starling (female).	Bangor.	"	5 large beetles and 1 small one; 2 larvæ and shells; spider; 2 small larvæ; 1 large caterpillar.	—	—	—	—	—	—	—	
F. G.	Bangor.	"									
Starling (female).	Llanfairfechan.	"	Scale leaves very plentiful, mostly vegetable.	Mallophaga.	Head.	—	—	—	—	—	
G. C.	Llanfairfechan.	"	General.	—	—	2 Acanthocephala; 5 Tapeworms	—	—	—	—	
Blackbird (fem.).	Llanfairfechan.	"				50-60 Round Worms.	—	—	—	—	
G. C.	Bangor.	"	—	—	—	—	—	—	—	—	
2 fowls (female).	Bangor.	"									
Rook (male).	Llanfairfechan.	"	Beetles; no scales; vegetable.	Numerous.	General.	—	—	—	—	—	
G. C.	Llanfairfechan.	March 13	Vegetable, &c.	—	—	—	—	2 Cestodes.	10 Tapeworms.	—	2 Tapeworms.
Thrush (male).	Llanfairfechan.										
V. G. C.											

*COROPHIUM LONGICORNE*: AN ORNITHOLOGICAL  
STUDY OF A CRUSTACEAN.

By F. J. STUBBS.

DURING the summer of 1913 I spent some weeks as the guest of Mr. J. Franklin Kershaw at his house on the Kent Estuary, in Westmorland; and, as the garden where we spent much of our time reaches down to the tide-mark, I was able to make a long series of connected observations on the animal life of the sands. Besides the wide areas of vegetated *salt-marsh*, there is a great stretch of level sand which is covered by the sea only during the highest tides once a fortnight; and in each intervening fourteen days there is a period of over a week when the shore is never covered and remains quite dry.

For my present purpose I took an area of one square mile of sand lying between Arnside and Sandside. The sand here is somewhat muddy, and, between the tides, unusually firm and smooth of surface. A motor cycle (as I noticed one day) leaves a mark no more than an eighth of an inch deep; yet, when I held an ordinary garden spade upright on the dry sand at the edge of a pool, and rocked the handle gently from side to side without applying any downward pressure, the implement in less than a couple of minutes sank so deeply that it could not be withdrawn by a direct pull. These remarkable quicksands, which occur on many parts of this coast, sometimes collapse beneath one's feet in an alarming manner, although a moment before the surface had been hard, dry, and apparently solid.

This square mile of firm level sand in front of the house—and I exclude now the salt-marsh, the permanent pools, and the regular channel of the river—supports a wonderfully simple invertebrate fauna and practically no plants. Once or twice I noticed a faint green tinge over a few square inches of sand, possibly due to the alga *Halosphaera*; and, very rarely, a few fronds of *Fucus* were left behind by the tides. The molluscs

*Tellina* and *Hydrobia*, abundant lower down the estuary, were here very scarce ; and the only worm was *Nereis dumerilii*, which existed in very scanty numbers in burrows half a yard deep, and was apparently absent from large parts of the ground. *Arenicola*, although abundant in Morecambe Bay, and at the mouth of the estuary, did not occur on the area I examined at Sandside.

The dominant animal was the Amphipod crustacean, *Corophium longicorne* ; so far as I know, there was no part of the shore free from this organism. It burrows in the sandy mud, making U-shaped passages about two inches in depth, and throwing small castings on the surface. In an aquarium these castings take the form of fairly stable tubes projecting for half an inch or so above the sand, but in the moving waters out of doors, or on the exposed surfaces, the material is merely piled up at the mouth of the burrow. The castings indicate the presence of the animals ; and, as I have said, this square mile of sand was dotted with them. Their number varied, but I did not take the trouble to count the castings ; I did, however, make many counts of the numbers of crustaceans present in different square inches of sand, never seeing less than fourteen, nor more than thirty-five. Near Humphrey Head, on the Lancashire coast, the animal is unevenly distributed, being absent from the pure sand, and abundant in the muddier gutters ; and in these I found that a single square inch of sand contained over fifty crustaceans in various stages of development. In September Mr. A. Rodgers, examining the shore at Silverdale for me, found them quite absent from the great stretches of the comparatively pure sand.

For the present investigation round numbers will be quite sufficient, and we can take twenty as the number of crustaceans inhabiting each square inch of the shore at Sandside. Eleven animals of various sizes picked at random and drained on blotting-paper weighed altogether exactly two grains, and this gives us a total of over seven hundred tons of these crustaceans for the square mile. The preponderance of *Corophium* over all other forms of visible invertebrate life enables us to dismiss the molluscs and worms, and the resulting simplicity allows us to consider the subject from an interesting point of view.

The burrows I examined never reached a greater depth than two inches, and most of them were little more than an inch. I

know nothing relating to their enemies when the water covered the sands, but clearly during the dry week of each fortnight they could only be preyed upon by birds; and my observations were directed towards the latter creatures. Here was a matter of seven hundred tons of food lying a couple of inches beneath the surface, and, one would think, open to the attacks of many shore birds. From July 23rd to August 18th, with one or two slight breaks, I was either on the sands or within sight or earshot of them at all states of the tide, and all parts of the day; the keen eyes of my wife and of my host were also pressed into these studies. The results are interesting chiefly from their negative character.

The actual channel was comparatively rich in life—Shrimps (*Mysis* sp.), immature Herring, Sprats, Spotted Gobies, Flounders, Sea Trout, and Sand Eels. From the refuse thrown up by the nets of the salmon fishers I took a Smelt and many of the curious *Aphya minuta*, our smallest vertebrate. These no doubt were the attraction for a flock of about a score of Arctic Terns (*Sterna macrura*) and one Little Tern (*S. minuta*) that appeared on August 8th. A heronry two miles away was seldom represented on my area, and I never here saw a bird fishing. Curlews were noisy and moving all the time, but as they confined themselves to the tidal pools which I knew to be full of young Flounders, Gobies, Shrimps, &c., and as I never actually saw them working the uncovered sands, I will omit these also. Twice in July I observed parties of eight or ten Dunlins (*Tringa alpina*)—in full breeding plumage, and perhaps belonging to the large race—feeding on *Corophium*; on both occasions they were accompanied by a pair of Ring Plovers (*Ægialitis hiaticola*). The Common Sandpiper (*Totanus hypoleucus*) kept strictly to the water's edge, as did the few Redshanks (*T. calidris*) that were about up to the first days of August. The Green Sandpiper (*T. ochropus*) did not appear until the 18th, when I saw one in a gutter on the marsh. The Lapwing (*Vanellus vulgaris*) was constantly present at the edges of the richer pools, and a small number—not more than thirty—were generally to be seen about the wetter portions of the newly uncovered sands. Possibly these were feeding on *Corophium*, but this is doubtful; in one instance the small shell *Hydrobia ulva* was the attraction.



The only other wader coming to my notice was the Oystercatcher (*Hæmatopus ostralegus*), a common bird in this part of England. On August 14th a flock that I estimated to contain six hundred birds came up the river, and we saw two other large bodies join the first one. Altogether there must have been not less than a thousand birds—more, one thought, than could have been hatched in the whole of England. After performing a number of striking aerial evolutions they vanished over Morecambe Bay, and we saw them no more. The regular “garrison” of my square mile consisted of about eight Oystercatchers. These were very tame, coming to within a few feet of the garden, and sometimes I saw one prod the dry sand with its bill, obviously in search of *Corophium*; but after perhaps a score of thrusts the bird would return to the pool. The marks of the bill on the level surface were visible from a distance of many yards.

From my observations I conclude that in Westmorland at least this particular crustacean is quite well protected from waders. *Corophium* is described by Quatrefages as a migrant on the coast of France, appearing in swarms in April, and vanishing suddenly in October—in a single night, he states. On November 7th Mr. Kershaw wrote from Sandside:—“*Corophium* now very scarce, and I dug in a dozen places before finding any. Towards the mouth of the estuary they seem commoner. Some of the burrows now go down for five or six inches”; and in December they were still present in small numbers. For the present I would suggest not migration but hibernation, either by means of eggs or fertile females, and a seasonal summer abundance, as in the case of so many invertebrates. But clearly there is much to be learnt about the species. Indeed, in Spence Bates’s work on the ‘Amphipoda’ (p. 281), the author cannot even be certain that *Corophium* makes its own burrows. I can decide this, for those I kept in an aquarium burrowed at once, and in due course formed the tubular prolongations of the mouths of the galleries which I have already described. A number of crustaceans were dissected, and cleared for microscopical examination, but without any success in ascertaining their food.

As the summer advanced, ducks in increasing numbers used the sands as a diurnal resting place. The majority were Mallard

(*Anas boscas*), but I saw one lot of Teal (*Nettion crecca*), and recognized several Shovelers (*Spatula clypeata*). By the way, the latter bird is far more of a salt-water duck than is generally supposed. I have observed it both on the Lancashire and the Scottish coasts, and on three occasions I have found the stomachs (including that of an Irish specimen) full of the shells of *Hydrobia*. I saw none of the above three ducks under circumstances which suggested that they were interested in *Corophium*. The Shelducks (*Tadorna cornuta*) came up each day with the tides, and worked the shallow pools in a half-hearted manner; and as these waters held nothing except the crustaceans, I must include the bird as an enemy, but almost a negligible one, of *Corophium*.

A mile or so distant from the area under observation there is an important breeding place of the Lesser Black-backed Gull (*Larus fuscus*), and throughout the spring and summer the sands are crowded by the birds. But I never saw one of these Gulls attempt to disturb the crustaceans, and do not hesitate to say that *Corophium* is not a regular item of food for the species. Out in Morecambe Bay the Kittiwake (*Rissa tridactyla*) and the Herring Gull (*Larus argentatus*) were numerous, and I saw a single Common Gull (*L. canus*) inland near Kendal on August 9th; none, however, was noticed at Sandside during my stay, and the only other Gull besides the Black-back was the ubiquitous Black-headed Gull (*L. ridibundus*). On my arrival I found a few young and adults settled on the sands, and when the Black-backed Gulls vanished (August 1st-5th), there was a great influx of Black-heads, and these commenced immediately to prey upon the crustaceans, and confined themselves to this diet. It is quite possible that the Black-backs from the great Foulshaw gullery move *northwards* in August, for, at the end of that month, in 1910, I noted the species as the commonest Gull amongst the lakes; and in a flying visit at the beginning of August few were to be seen.

At this point we may stop to consider that on this square mile of sand, and within two inches of the surface, there are seven hundred tons of animal food untouched by terrestrial vertebrates, and brought within reach of aquatic organisms for but a very short period each fortnight. The birds which visited

the estuary, with one or two negligible exceptions, made no attempt to reach the crustaceans; the faithful surface of the sand recorded every disturbance of the burrows; and although it was natural to think that a restless party of birds were actually feeding, a subsequent examination of the spot, or careful observation through our glasses, proved that the *Corophium* burrows were not disturbed.

The Black-headed Gulls, although feeding exclusively on *Corophium* for many days, were powerless to reach the crustaceans inhabiting the uncovered sands. They could catch only those living in sand covered by water, and if the water was more than three inches deep they were again powerless. Each pool, however, shrank visibly from day to day, until the water vanished completely; and thus each day brought a smaller ring of new ground within reach of the birds. The method employed in feeding, although often observed, and described in several northern journals, seems to have escaped wider notice in the regular literature of ornithology.

The Gull stands in the water, and, holding its body horizontally, dances vigorously with alternate steps for a minute or more, but with no change of position. This action on the sand, possibly by filling up the burrows, alarms the crustaceans, which rise to the water and scatter in flight. As soon as they appear the bird stops its dance for a second or so, and, still remaining precisely in the same spot, snaps in the water at the swimming animals. On imitating the action with the tips of my fingers, and of course with the same result, I found that the crustaceans were readily detected by the sense of touch as they struggled to the water; and this suggested the possibility of the webs of the Gull's toes being used as tactile organs. The point is well worth consideration, for if established it would explain the presence of highly developed webs in birds which are addicted to wading but rarely use their feet in swimming.

Sometimes a Gull would remain in one spot for so long a period as half an hour, gravely and patiently dancing the whole of the time. The result would be a crater-like depression six inches in diameter and an inch deep; but, if the birds were not disturbed, they would move gradually backwards, and in the course of a few hours make shallow furrows varying in length

from a foot to twelve yards. One furrow that I measured was exactly twelve yards long, and had occupied its maker for at least three hours, and possibly twice this time. Now, allowing the width of the disturbed sand to be six inches (really this is the distance between the summits of the ridges thrown up on each side of the furrow), and the number of crustaceans twenty to the square inch, we find the total weight to be about a pound and a half. The greater part of this would go down the throat of the bird, for I do not think that many of the crustaceans are allowed to escape once they are driven from their burrows.

As the pools diminish in size these curious markings are left on the bare sand, sometimes in great numbers where the Gulls have been congregated. I do not know if anyone has ever noticed these very conspicuous furrows, but I should expect them to present rather a stiff problem for an enquiring mind who did not think of the agency of birds. I ought to add here that I have often observed this very extraordinary dancing habit of Gulls on other estuaries, but I think it safest to say that I have no note of the actual species, nor of the food sought. Possibly the Black-headed Gull may prove to be the only species addicted to the habit, for I have seen it so employed while in the immediate company of other Gulls that stood by and looked rather hard-up for a meal. On the estuaries of the Conway and of the Clwyd I have sat and watched the Gulls dancing in the mud on very many occasions.

In the summer of 1912 a tiny sandy bay on the north coast of Yorkshire was swarming with Sandhoppers (*Talitrus locusta*),\* and each evening a flock of a hundred Black-headed Gulls, accompanied by either two or three immature Kittiwakes, patrolled the sands, snapping up these agile crustaceans. Each bird marched steadfastly forwards, and picked at any hopper that happened to be in the air within a couple of inches of its beak at the moment the bird had disposed of the last one captured. The resulting gait was indescribably ludicrous to watch, for it resembled a violent form of palsy as the accompaniment of a

\* Possibly this is the species that crammed the stomach of a Cuckoo (*C. canorus*) shot by Dr. Stejneger on the coast of Kamtschatka. He called them "the *Gammaridæ* which abound on sandy beaches."



preternaturally grave and decorous walk. Thus the whole flock marched on, each head bobbing with clock-like regularity, and in apparent aimlessness; but probably most of the snatches were successful, although of course we were too far distant to detect the actual insects. When it was too dark to read we could still see the Gulls working as freely as ever, and could not but admire the perfection of eye and beak that made this business possible.

On our Westmorland estuary we found the young birds of the year, fresh no doubt from the great Ravenglass gullery, as assiduous as their elders in the remunerative dance. At night, when it was too dark to see them, we could plainly hear the measured splashing from the tireless birds; and in what way are we to understand how they were enabled to see the crustaceans through a couple of inches of disturbed water? Bad enough in the daytime, it is either worse at night or—the Gull has a sense of sight of a quality unknown to us, and with powers that merit a position as a sixth sense. There are many published records of the Black-headed Gull catching insects in flight, and it has been observed that regular aerial feeding excursions are made after dark.\*

The fauna of the more or less permanent tide-pools was too complicated for exact observations, but the shallower pools could be surveyed with great convenience, and I was able to convince myself that, exclusive of microscopical organisms, they were inhabited only by *Corophium*. Gulls, therefore, which were seen at these places could be feeding only on this crustacean, and on nothing else.

I would like again to draw attention to the fact that birds of the year were using this curious "dancing" method of obtaining food in July. Is it instinctive? If not, and if they were merely following the example of their elders, why did not the Kittiwakes off Grange copy their companions? Do other birds, in other localities, feed on *Corophium* or similar sand or mud inhabitants in a similar manner? Do the Gulls tread out other inverte-

\* Perhaps here I can repeat a note (cf. 'Naturalist,' 1908, p. 456) of my own on a Buffon's Skua, the stomach of which contained the remains of Crane-flies and a species of Syrphid, the last recognized by the characteristic "false-vein" of the wings.

brates besides *Corophium*? These matters may be worth the attention of ornithologists.

P.S.—Writing on January 28th Mr. Kershaw says:—"I have not seen more than three Gulls on the sands for weeks. They are Black-heads, and the black feathers are beginning to come. One is the bird I mentioned before—it trails one wing, but seems to fly all right. . . . Yesterday I marked out two areas of sand, four inches square each, one on the edge of the solid sand near the high-water mark, and the other farther out. I dug down for about six inches (although none of the burrows went down farther than three inches), carried the sand indoors, and passed it carefully through a muslin sieve. There were forty-six *Corophium* Shrimps, three Worms (*Nereis*), and a few (*Tellina*) shells about an eighth of an inch long. . . . I have not seen any Gulls 'dancing' lately."

According to these observations the crustaceans are fourteen times more abundant in July than they are in January; and, clearly, their disappearance cannot be put down to migration. Ornithologists are only too well aware of cases where the phenomena of migration have been explained by a theory of hybernation, but I cannot recollect an instance like the present case of *Corophium*, where *migration* has been suggested, when hybernation appears to be the fact.

## A DIARY OF ORNITHOLOGICAL OBSERVATION MADE IN ICELAND DURING JUNE AND JULY, 1912.

BY EDMUND SELOUS.

(Continued from vol. xvii., p. 422.)

*June 17th.*—The quest of the Falcons having failed, and Sigurdsson having told me that a small river which ran into a lake near the one where I had watched the pair of Great Northern Divers, was the haunt of the Horned or Slavonian Grebe, we returned to-day, and pitched the tent upon the crest of a low hill, overlooking both the one and the other. The river, in its general course, was a mere stony burn amongst low hills, but, upon coming out from amongst these into the flat, marshy land at their bases, formed a small creek running parallel with the lake, for some way, before curling round the hill I have spoken of, to join it. In England there might have been both Moorhens and Dabchicks here. The water was weedy, and flags grew in patches, here and there, along the green, marshy banks, but so thinly as not to conceal, except at some distance, either the bird or the nest. There were two of the latter, the probable owners of which disappeared at our approach, but I was in time to see one pair, whose Dabchick-like character I recognized at once, through their superior plumage, engaged in the performance of what was probably a courting action, though it may be more developed earlier in the season. The two birds fronted each other, then rose, both together, Penguin-like, in the water, and, after a moment or two, sank down upon it again.\* I was now left alone, with the tent, but as this had been designedly pitched so as to be invisible from that part of the stream which I intended to watch, I soon left it and sought out a place of espial

\* The Great Crested Grebes do the same (though I have seen them do more), as also the Red-throated Divers.

on the slope of the hill, right overlooking one of the nests, and near enough to it to give a capital view with the glasses.

This was about 9 p.m., and, for some forty minutes, there was only the pleasure of expectation, which, however, with anything like certainty at the end of it, is a sufficiently keen one. Then a pair of the Grebes swam up the stream from the lake, in a very purposeful way, without any stopping. They entered the clump of rushes, and, making directly for the nest, the female sprang up and lay all along it, just as the Great Crested Grebes that I watched in Suffolk used to do, as a preliminary to coition. The male now came up to the nest, and remained by it, for a few minutes, then turned and continued to swim up the stream, and the female, after remaining in the same attitude, for a few moments, with a quick motion, raised herself and slid off into the water. I assume, from her actions, that she had ascended the nest with the special object alluded to, though the male, for some reason—just as was so often the case with the last-mentioned species—failed to respond to the invitation. Some little time afterwards, the birds came again, and exactly the same thing took place. The attitude of the female, with the head and neck laid all along on the flat platform of the nest, was unmistakable, as, for a moment or two, the intent of the male was also, for he was, again, half-hearted, and did not come up on the nest. Twice after this the pair swam up again, but the nest itself was now the matter of interest. They dived twice or thrice, close about it, and after each time the female jumped up on to it, and moved and arranged its materials with her bill. That she brought something to it, each time, from the bottom seems likely in itself, but I could not observe that she did, and as a considerable part of the nest must lie below the surface of the water, she may have been paying attention to this. Neither could I observe that the male brought up anything and added it to the structure. This probably means that he did not, nor did he ascend the nest, but there can be no doubt that he, too, was interested in it. Another time the female came to the nest alone, jumped up on it and remained there a few minutes before leaving it again.

These Grebes uttered various sounds when visiting the nest, both as they swam up the stream, and when in its near neigh-



bourhood, but not when actually by it. One of the notes was a sort of soft chuckling cackle, and there were various other ones very suggestive of satisfaction, which I cannot recall sufficiently to set down. Another note often uttered, but not, I think, by one of the pair in question, was a sort of mewling sound, followed by a deep guttural one. Altogether there was a great variety of utterance.

*June 18th.*—It was a little past 6 a.m. when I first looked at my watch, and, about an hour afterwards, I saw the pair of Grebes swimming up the stream in the same purposeful manner as yesterday, and also the last thing overnight, as I was getting my bed ready—at a quarter to one, namely. I was now dressed, and creeping down to my place of observation, behind some low rocks on the hillside, was so lucky as to see both birds, together, upon the nest, the female lying along it in the manner described, and the male a little raised on his feet just behind her. The next moment he stood upright, or nearly so, and coition was effected. During its continuance, both birds constantly uttered a short, sharp note, which was shriller, I think, in the male than the female—at any rate, both were not alike. After coition, the birds came down, off the nest, and, for a short time, kept quiet amongst the flags. They then came out upon the open water, where, in a little pool-like bend of the stream, they floated at ease, together, and seemed full of content and satisfaction. Sometimes they dozed or went to sleep, and I noticed that their sleeping attitude was not the general one of birds. They drew back the head, indeed, but without turning it round, and pressed the beak into the feathers of the throat or upper breast, instead of hiding it amongst those of the back and shoulders. The head itself, however, was thus brought right into the middle of the back, and looked like nothing so much as the little knob on the top of a pork pie. In this attitude they seemed to be really asleep, for the brilliant, light ruby-red eye was invisible through the glasses, though quite plainly seen at other times. After awhile, one of them began to dive for food, and, though the water was not clear, I could each time see it go down for some way, and the body always presented a smooth, oval outline, showing that the wings were not used under the water, as they are by various diving birds. The legs were always

visible whilst the bird was, and once I clearly saw them in action. The dive was always in the Shag or Cormorant style—a leap up, and then down, that is to say—but not with the same verve and energy, nor would it be expected of these soft and rounded little creatures, slightly enlarged and much glorified Dabchicks. So far as I was able to observe, I believe it was weed this bird was feeding on—at any rate, I never saw it with a fish in its bill. When the one bird had fed and the other rested sufficiently, both swam together down the stream in the same intent, business-like manner in which they had ascended it, and I thought they were going out into the lake. But they soon stopped, came back again, and again preened and idled on the water. It was now that I twice saw them go through the same courting action which I have before described, the only difference being that it was a little less pronounced. They did not, perhaps, stand quite so bolt upright in the water, at any rate they had a little stoop forward, and subsided, again, almost immediately—it was more perfunctory in fact. Two or three times, also, when thus in each other's company, they both, as on a common impulse, swam up closer together, and then, fronting one another, with beak turned to beak, but not now touching, and without rearing themselves up, made a curious little twittering cry, thus presenting exactly the same little scene of reunion and mutual expression of gladness as I have so often seen pass between the male and female Dabchick. The note, however, was not nearly so shrill, nor did it rise in intensity, as with the latter, so that the performance was not quite such a striking one. Also, like Dabchicks, these beautiful little Grebes would, sometimes, whilst swimming—generally when in full swim, so to say—make a little pause and, almost instantaneously, a little, gentle rise of an inch or so out of the water (too soft to call a jump), just showing the silky white of their breasts before sinking down again, and swimming on. So like Dabchicks are they, indeed, that I believe, with the exception of the notes, which are not the same, and of which they seem to have a greater variety, an accurate description of the habits and actions of the one species would be equally accurate for the other. This, however, may to a large—perhaps to an equally full—extent be said, substituting the Great Crested Grebe for the Dabchick. Unless for some special

development which has not yet been recorded, it seems probable indeed that all the members of the family have the same habits.

After a short interval, filled up in these various ways, this pair of Grebes swam down the stream, but at a certain bend of it, in which was the next defined patch of rushes, the male of another pair that had made these their headquarters made a little bull-like rush out from them at the intruding male, as he chose to consider him, holding his head down on the water, and advanced like the ram of a battleship. The latter was put to flight—actual flight for a little—for some way down the stream, and then went on into the lake. The female was not interfered with, nor yet when sometime afterwards she approached a narrow, fringing belt along the shore, opposite the larger one. She then swam back, up the stream, into her own home-waters, where I lost sight of her, for after keeping, a little, in the neighbourhood of the nest, she left it, and went on. Some time after this—about 10 a.m., to be precise—I saw the male of the other pair of Grebes swim from his clump of rushes to the opposite side of the stream, and there, just off the shore, take up some weed or other material in his beak, and return with it to the nest. This he did several times, at short intervals, sometimes diving, but, as it seemed to me, more as on his way to one bank or the other than to get weeds from the bottom. This he may sometimes have done, however, though, if so, they can have been but small pieces, but, as a rule, he either took weeds from the surface, or pulled the growing flags. I kept expecting the female to come and share in the work, and more eagerly, but I only thought I saw her do so once, and now doubt if I did at all. I saw, however, both birds mount the nest, in succession, and then one of them again, at short intervals. Since I had been given to understand that there were no eggs, yet, in any of the nests of these Grebes, this only suggested to me that the birds were still building, and kept getting on to the nest, to arrange the materials they were bringing to it, especially as I thought I once saw the female doing so. Nevertheless remembering my experience with the Great Crested Grebe when in Suffolk, I determined to try a long and difficult stalk down the side of the hill on which I was, and over a considerable stretch of flat, tussocky grassland, to the bank of the stream itself, if possible, in order to watch the birds

more closely. This I succeeded in doing, part of the way on my back and the rest crawling flat, till I was at last so close that I not only saw the vividly bright ruby-red iris of the bird's eye, as it sat on the nest—which I at first thought a spot of red plumage—but the small light pupil in the centre, of a green-grey or yellowish colour. It was the female, not however occupied in building the nest, but merely stationary upon it, but it was not till I had got nearer still—perhaps within twenty feet—that I was able properly to distinguish the structure of the nest, amidst the rushes. I lay enjoying this close view, for some time, when I heard a very soft note, quickly repeated, something like "croo, croo, croo, croo, croo," which, though it got nearer, seemed hardly to get louder, till, at last, the male came stealing through the rushes, to the side of the nest, and, his partner coming off it into the water, he sprang up, and took her place. After a time, which, in my constrained position, seemed long enough, there was another change, but when the male, now relieved in his turn, began swimming up the stream, he must, I suppose, have caught a sight of me, or of something to make him suspicious, for, as far as I could hear only (I dared not now raise my head), he flew, for a little, along the water. Still the female kept her place, but, some time afterwards there was a sudden loud utterance of the curious mewling note I have before mentioned—a loud mew, in fact—upon which she showed instant anxiety, and quietly dropped off the nest. The male, however, in spite of his sudden alarm-note—for it must surely have been his—and previous flurry, came on to the nest again, but the female was now in a state of suspicion, to which her own observations kept adding, so, seeing that things would not continue longer in their natural course, if I remained where I was, I crawled away over the flat and up the hill again, to a point on the summit, from which I could still see the nest, with the sitting male. It was now, of course, perfectly evident that, in spite of the continued bringing of weed to the nest, incubation had begun with these Grebes, and also that both sexes shared in it. The subsequent intervals, whilst I watched, at which the pair relieved one another, were as follows. At about 12.30 p.m., the female, who had waited about, anxiously, to do so, and whose fears were now dissipated, took her place on the eggs. At 1, the male



returned, and relieved her. At 1.30 the female again took her turn. About five minutes before 2, the male reappears, and, in a minute or two, I see him leap up on the nest. I miss seeing the female come off, but she was on it up to a little before. In about a quarter of an hour, she returns, but keeps to the stream, and the male leaves the nest, to join her. For a few minutes, they swim about together, at one time, very cosily, side by side and almost touching. Then the female goes on, and the male brings some more material to the nest, for which he once dives. He then swims some way down the stream, but very soon comes back, and, at 2.25, the female leaves the nest, and rejoins him. They swim a little together, again, going down stream, but, very soon, the male returns, and, at 2.32, takes his place again. I fancy that in the interval between then and 4 p.m., when I went to my tent for breakfast, he must once more have given up his place, and afterwards retaken it. Of this, however, I cannot be sure, and he had certainly sat unrelieved for a considerable time before I left—comparatively, that is to say, for the quick intervals at which the two have relieved each other upon the nest is here the salient feature, and may be peculiar to this Grebe, since I have not observed it either in the Dabchick or Great Crested one.

There is no doubt as to the great beauty of this species. The rich russet chestnut of its sides, contrasting with the glossy slate-blue of the back, its neck russet also, the plum-bloomy ruff, the jewel-like eye and beautiful, almost golden, tufts of plumage on the cheeks—all this, with the silky and silvery white of the under surface which, when it rises on the water, is still its loveliest adornment, makes it one of the gorgeous-plumaged birds of the world, much more in keeping with a tropical landscape than with these cold and colourless regions. There, perhaps, it might purchase security by the fiery blending and salient inconspicuousness of its hues, but here it is as badly off for plum-trees or orange-trees as is the Tiger for bamboos, over the greater part of its range. It swims over waters that are grey, and by shores that neither in themselves nor through their reflections at all resemble its own plumage; and it makes its large brown nest amidst thinly-growing, green flags, and sits there with its head, like a small sun, shining above it, a ruby

set in each side the sun. Still, it must not be forgotten that there is the bird's own reflection in the water, with which, when sufficiently emphasized, it must harmonize to perfection. Here, then, at least, is one quite satisfactory background. I cannot myself think of another, but, should it still be thought necessary, there is no doubt one might be designed.

Still, with every assistance, and for all that has been said, these Grebes, as examples of assimilative colouring, seem to me to stand in a very different category to such a bird, for instance, as the Golden Plover. Whilst on the way here from the home-stead, a nest of one of these birds was located, and marked for me with a few turfs by Sigurdsson and, for some time now, I have watched the female as she sits with almost the whole of her body exposed, yet the mottled and nondescript markings of the back and breast seem to fade into the general coloration of the whole of the surrounding landscape, which is a wide expanse of brown earth, tawny grasses, and grey moss, in the unsalient interblending of which her own comparative insaliency is hardly to be distinguished at a moderate range, through the glasses. The general tone and colour-wash here seem designed for the eye to rest on, without being caught or detained, but this does not apply so well to the deep black of the throat, breast, and abdomen (speaking of the male more particularly) which show when the bird walks about. This, being the nuptial garb, has probably been gained through sexual selection, as, indeed, the golden back also, though in the latter there is far more reconciliation between two not necessarily opposed principles; for why should not sexual selection sometimes have operated under the control of the larger power, Natural Selection, which would, in this case, have fixed the kind and the limit of the adornment? Indeed, in a wide way, this must always be so, for directly the advantages gained by the race, owing to special attractiveness being acquired by the one sex in the eyes of the other, began to be overpowered through the greater destruction due to its consequent enhanced conspicuousness, this process would be checked, and a compromise between it and the other effected.\* With the Golden Plover, in

\* Of course all is really Natural Selection, and the seeming opposition merely a fluctuation in the manner of its action.

the breeding-season, the compromise appears to have been this, that it has been permitted to look conspicuous enough, whilst walking about, but not in the same degree, whilst incubating, since here the black parts, being undermost, are hidden, or partially hidden, whilst the mottled back, though more beautiful, is, notwithstanding, more assimilative. Partially hidden, I have had to say. The case, I confess, would show better if no such qualification were needed, but the particular bird which I have now for some two hours been watching, and which I believe to be the female, has sat all the while remarkably erect upon the nest. *En revanche*, however, she has also sat very motionless—I am hardly sure if I have seen her move once.

All over the country now, wherever these birds are at all (and they are widely distributed) one sees them and hears their plaintive pipe, and the conduct of any one of them that one approaches is generally in relation to the nest on which its partner is sitting. For instance, as I got up to the nest which I am now watching, the male of the pair was standing within a few feet of it, and as I advanced he moved away at but a short distance in front of me, showing an evident but yet moderate and well-governed degree of anxiety. Wishing to see how things would go, I followed him, and he kept for a long way at the same measured distance in front of me, stopping when I did, piping, as it were, conventionally, in fact, with professional adroitness, leading me away from the nest—for such certainly seemed to be his idea. Go where I would, I could not get rid of this bird. When I had walked to a distance away from the nest which I thought might certainly have satisfied him, he still kept about me, coming down, sometimes here, sometimes there, but never far away from me, and sometimes quite close. After some time I walked diagonally to another point, from which I could better watch the nest, nearer, indeed, but still at such a distance as, to a being with no knowledge of binoculars, might well have seemed perfectly safe. Now, for a little while, I thought he was gone, but, all at once, he was close at hand again, with his eye, as before, fixed professionally upon me, as though he had no idea of letting me get away. In fact, he watched and sentinelled me, nor was it ever possible to attribute his actions to causes irrelevant to myself—it was plain to the extremity of

plainness that they were in absolute *rapport* with my own. I sat in the place I had chosen for a long time—half an hour at least, or an hour—and began to think that I should never see the return of the female to the nest—for I had startled her off it in the first instance—when, all at once, my eye happened to catch her standing there, and putting up the glasses I saw her make the series of little advances, with short pauses between, which ground-laying birds are accustomed to do when returning to their eggs, and shortly go on to them. All this while the male Golden Plover had kept by me, but now he gradually and, as it were, in an un abrupt manner, took his leave, and for another hour, perhaps—more, I think, for it is now nearly 9 p.m.—I have been left alone. His cue apparently had been to watch me narrowly and, if possible, to get me away till his consort thought it safe to return to the nest, after which he was off duty. My own cue now, however, is to approach the nest again and see what happens. Accordingly I do so, but nothing happens that happened before, for the female bird sits on till I am almost on her, and there is no male to divert me this time. Still I feel sure that the one that was there and watched me so narrowly was the sitting bird's mate. He cannot, after all, be always at the nest.

Returning, now, to the tent, I have the unexpected pleasure of seeing four Great Northern Divers swimming on the lake together. Fine handsome birds they are, with their bold contrasting colouring of black and white that would flash finely in the sun, if there were one, as I have seen it do, in snatches, with a single bird; but there is no sun now for this great state occasion. They have a majestic appearance, one may almost say, with their velvety black heads and necks of the same, set off with their white semi-collarets. They are like superb Spanish beauties, with raven hair, in black mantillas, and finely developed, but they have not the soft grace and loveliness—for it amounts to that—of our own Red-throated Diver (our own, because it breeds with us) whose charm is more subtle and captivating—a fay, an Undine. All these four birds swim with a curious sort of uncertainty, seeming to have no fixed purpose or direction, so that the deviation, by ever so little, of any one of them from the line of advance is a reason for any or each



of the others deviating in sympathy, and thus they become grouped, separated and amalgamated again, as each draws or is drawn by another. They have a habit of stretching out the head and neck along the water, and swimming so deeply that sometimes only the upper line of these and the top of the back—or even that alone—can be seen, but whether they are fishing or drinking, or engaged in anything special, when they do this, I cannot make out. Sometimes two would come together, as though by mutual attraction, seem about to touch with their bills, then both dash under water, as in coquetry or bashful confusion. As their mood grows more sprightly, first one and then another takes wing, rising with a great deal of preliminary flapping along the water, flying then, for a little, low over it, and coming down on it again. In this last I made special note of the mode of transition from flight to natation, as shown more particularly by one of them, or rather I concentrated my attention more strongly on this one—no doubt the performance was representative. Instead of descending upon the water at a slant, as does a Duck, and as I have seen the Red-throated Diver do, he sank down upon it while flying quite horizontally, and yet not abruptly so, but very gradually—a mode which had a curious new grace in it. At length, one of the quartette flew round a bend of the hills, probably into some other sheet of water, opening out from beyond where this lake narrows, at what seems its one end. Then, from the distance, came the quavering note which I have described, and, before long, first one of the remaining three, and then the other two, flew after and were lost to me.

Of the two pairs of Horned Grebes that have taken this little stream—or rather this little end of it, which, alone, is adapted for the purpose—as a breeding-place, I doubt if the birds that have eggs ever go abroad on the lake together, or, at least, not often or for long. The other pair, however, that have not yet laid, resort there at intervals, and disport themselves on its broader expanse, in a larger and wilder way. I noticed them diving, splashingly, and then, for a time, going only just beneath the surface—in frolicsome mood, as it seemed. From these merriments they repair to the nest, both to add to its structure, and also for the special purpose, as is now apparent,

of coition upon it. Evidently the nest, with this species, as with the Great Crested Grebe—probably the whole family\*—is “love’s roseate bower.”

Wishing, now, to see if they also shared the habit of covering the eggs, when leaving them, with some of the materials of the nest, I walked along the bank of the stream past that one of the two nests belonging to the incubating pair. I have no doubt the bird was sitting at the time, but it was sufficiently wary to let me see nothing of it, and when I passed, two eggs alone were but partially visible through pieces of flag laid across them. This is just what it might have been with Dabchicks, in which species (as I have personally ascertained) the habit is neither invariable nor always completely carried out. As the number of eggs laid by this Grebe varies (we are told)† from two to four, I cannot say whether there were more than these two, in the nest, but completely covered.

(To be continued.)

\* As also (I can now add) some other families.

† Dresser’s ‘Birds of Europe.’

## NOTES AND QUERIES.

## AVES.

**Status of Blackcap and Garden-Warbler.**—I can assure Mr. Gill\* that in this district, or perhaps I ought to say on this property, the Blackcap far out-numbers the Garden-Warbler, and is, in fact, our commonest Warbler. In forty years I have found but three nests of the latter, whereas in any normal season one could find upwards of thirty nests of the former. I have always been most careful about the identification, and have invariably watched the bird *on* the nest when there has been any possibility of a mistake. It is very curious, and I can see no reason why one bird should be so rare and the other so common, when the locality seems equally suited to both. Some years ago I spent several days in the Blagdon Valley, and thought Garden-Warblers slightly predominated over Blackcaps. In Hungary, where both species are numerous, we found about an equal number of nests of each.—HEATLEY NOBLE (Temple Combe, Henley-on-Thames).

**Waxwings in Suffolk.**—The first we heard of the visitation of the Waxwing (*Ampelis garrulus*) was on Christmas Day (1913), when my daughter reported two seen on Dec. 22nd close to their house at Rougham by her husband and herself. They got a good view of the birds through glasses at less than twenty yards' distance, and could distinctly hear the call they gave. The Waxwings were feeding on hips, and were fortunate in having the glasses brought to bear on them instead of a gun.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds).

**Nutcracker in Surrey.**—By editorial request I have pleasure in sending particulars of the Nutcracker in my possession, which was taken in Addington Park, Surrey, on October 14th, 1913. The reason for not recording it before is because I sent it to my nephew, who forwarded it to Mr. J. A. Coward to identify and get properly stuffed, and it was returned this week with his remarks. It is the slender-billed form (*Nucifraga caryocatactes macrorhynchus*). Its habitat is,

\* Cf. ante, p. 36.

roughly speaking, Siberia, and a winter wanderer westward into Europe; while, strange to say, it is more frequently met with in England than the thick-billed Scandinavian bird. It breeds in the mountainous regions of Europe as far south as the Pyrenees, is found eastward to Japan, and is of casual occurrence in Great Britain. Hartert (?) classes it as a vagrant, and there are about forty authentic records of its occurrence. It inhabits elevated forests chiefly of coniferous trees. The specimen referred to was found in some Scotch firs at an altitude of 460 ft.—EDWD. N. MENNELL (The Hostel, Shirley, Croydon).

**Hybrid Ducks.**—With reference to Mr. Panton's notes (*ante*, pp. 33, 34) I may say that in 1912 and again last year a Pochard drake paired with a female Sheld-Duck in Christchurch Park, Ipswich. One young bird was reared in 1912, and two last year, which were all alive and well on Dec. 23rd. They are handsome birds, more like the Pochard than the Sheld-Duck, both in habits and plumage. Mr. Damant, the caretaker of the birds in the park, takes great interest in his charges, and would, I am sure, be pleased to show these hybrids to any naturalist. They are quite tame, and will come for food offered them.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds).

**Muscovy and Duck.**—In Mr. Panton's article on "The Relationship of Species," he includes in class C as animals producing sterile young the Duck and Muscovy, and states that in this class hybrids are hard to get. Also, that "there seems to be less attraction between the combining animals, and they have to be kept together, and away from their proper mates, before they will copulate." My experience of the Muscovy is that he is a general nuisance, and will copulate with any of the *Anatidæ* at all times, from a tiny call duck to an Egyptian Goose, and also that the results are fertile, judging by the awful mongrels too often to be seen in our public parks. It may be of interest to state that, at a farm in North Lancashire, Muscovys were nesting on the crossbeams in an empty barn thirty or forty feet from the floor. They were seen to fly through the ventilation holes, and, on investigation, we saw them walking along the beams to their nests, which were situated where two beams crossed. When the young hatched, they were simply pushed off the beam, to fall on the floor, without being damaged, just as Mallard have been seen to do when nesting in a tree.—H. W. ROBINSON (Lancaster).

**A January Corn-Crake.**—On January 27th a strange bird was shot near Oxted in Surrey and sent to me the next day for identification.



It was a Corn-Crake (*Crex pratensis*), in decent condition, and half through the moult. Winter occurrences of this species are always worth recording, especially in connection with south-eastern England, where the bird is now rare and not familiar to sportsmen.—F. J. STUBBS.

## PISCES.

*Neoceratodus forsteri* in Queensland.—This fish, commonly known as the Burnett Salmon from its flesh, is still abundant in the only habitat in which it survives, the Burnett River, South Queensland. As an angler was fishing in the river recently, with a net some sixty yards in circumference, he enclosed, and in three hauls captured, no fewer than twenty-four specimens of this unique "lung-fish." Some of the fish were very large, and the weight of a portion was stated at 90 lb. per fish.—JAMES TROUBRIDGE CRITCHELL (22, Basinghall Street, E.C.).

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## NOTICES OF NEW BOOKS.

*The Snakes of Europe.* By G. A. BOULENGER, LL.D., D.Sc., F.R.S., &c. Methuen & Co., Limited.

"THERE is no work in the English language dealing with the Reptiles of Europe." This is the first sentence in the Preface, and is no longer true, for Dr. Boulenger has now adequately and authoritatively supplied that want by the publication of this volume. He has also, again, cleared the ground from some early misconceptions, for in his family divisions "the presence or absence of a poison organ is left out of consideration," and the definitions of the families are based exclusively on osteological characters. Coloration and markings are also shown to be often but secondary and sometimes misleading guides in the discrimination of species. "If we were to be guided by colour and markings alone, how could we believe that an adult four-lined *Coluber quatuorlineatus* is of the same species as the handsomely spotted *Coluber sauromates*? and yet if we

compare the young of these two snakes we find them to be absolutely identical in their markings, and, in the absence of any structural differences, we are forced to conclude that they only represent two forms of the same species, of which the latter is the more primitive." Again, colour and markings are frequently, perhaps too frequently, employed in theoretical conclusions and suggestions. Such an instance is found in the eye-spot on the hood of the Indian Cobra. But, as Dr. Boulenger observes, "at present it is as inexplicable as the lugubrious emblem on the thorax of the Death's-head Moth. It cannot be suggested that it is a warning mark intended to terrify intruders, for when the Cobra is at rest the hood is folded, and the characteristic marking is not displayed; whilst, as soon as it is aroused and the hood expanded, it faces its enemy in such a way that the spectacle, or ocellus, is not to be seen." Again, as regards the now excessive advocacy of "mimicry"; among Snakes "there are equally striking instances of what one would regard as mimics if they only occurred together; thus, there is no better case of general resemblance between a poisonous and a harmless Snake than we find in the Indian Cobra and the *Coluber corais* of Tropical America, where Cobras are absent, or between a Viper and the Boid *Engyrus asper*, from New Guinea, where no Vipers exist."

But we must quit these delightful realms of philosophical zoology or a wrong impression may be given of the book. It is practical to the last degree, and the naturalist and student will find, by description and illustration, what he requires to aid him in the identification and knowledge of European Snakes, the British species being thus included. There is a good and useful bibliography, as well as distributional lists to readily enable the student to follow the range of species in the different parts of Europe.

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*The Life of the Mollusca.* By B. B. WOODWARD, F.L.S., &c.  
Methuen & Co., Limited.

IN this book Mr. Woodward has had the somewhat difficult task of combining a description of the well-known outer coverings or shells with that of the living animals within them. Both

are necessary to a knowledge of the Mollusca, but we so frequently find the study of one branch naturally, and necessarily a museum one, in the ascendancy, or contrariwise an anatomical or physiological one, which is more adapted to the laboratory and less to museum purposes. Mr. Woodward has succeeded in his twofold task, and from his precise and yet constrained method the reader can at once see that he could have filled a second or even a third volume, had opportunity been afforded him. The zoological literature of the future will probably be that of the big volumes rather than that of the compressed handbooks, for the results of bionomical observations and evolutionary conclusions have now ceased to be the points for footnotes and have become the subject-matter of chapters; and this is the charm of modern zoology which our author has fully shown in these pages. Thus we are told: "The mottled markings on the shell of the common Garden Snail play on a small scale the same part that they do in the Giraffe, and serve to make the wearer less conspicuous in the shadow of vegetation. The dun colour of the Desert Snail (*Helix desertorum*), like that of the other desert animals, harmonizes with the prevailing tint of the habitat. The arboreal *Ariophanta dohertyi*, of Sumatra, is of a delicate green colour, and almost invisible among the foliage on which it dwells. Many of the Slugs, by their colouring and markings, are rendered inconspicuous in their natural surroundings, such as *Limax arborum* on trees, *Geomalacus* (the Kerry Slug) on lichen-covered rocks, &c." It is these observations which give to shells an interpretation in nature, apart from their interest in the conchological cabinet.

"Classification," "Geological History," and "Present History and Distribution" are also adequately described, and we, at least, know no book where the molluscan story is so fully told, and where so much information can be obtained in a small compass. We wish, however, that if a bibliography was impossible by exigencies of space, some bibliographical references could have been added to the text, so that the less informed reader could more fully follow up many of the interesting and important facts and observations referred to. Mr. Woodward has told us so much that we would fain know more.

*Camping in Crete.* By AUBYN TREVOR-BATTYE, M.A., F.L.S.,  
&c. Witherby & Co.

MR. TREVOR-BATTYE has written a most interesting book on an island well known for its archæological treasures. Its zoology is also peculiar and important in its derivation, for we have been already told by Dr. Scharff that "no less than seventy-seven molluscs of Crete out of one hundred and twenty-one inhabiting the island are peculiar to it." Mr. Trevor-Battye himself has added a Shrew (*Crocidura canea*) to the list of its mammalian fauna, and has compiled an interesting list of the birds seen or obtained between "March and the end of June." He has also given an enumeration of the conspicuous plants which he observed or collected, with the very justifiable remark that his list may be found useful by future visitors to the island.

The reader will soon find himself on intimate terms with the author of this volume. He writes of "terrestrial animals (other than man)," a philosophical conception not always apprehended by claimants to the absolute distinction of *Homo*. Mr. Trevor-Battye's experience at a certain monastery is distinctly entertaining. He mentioned to the priests and deacons therein how interesting the story of the visit of Paul to Crete and the shipwreck chapter as detailed in the "Acts" must be to them. "The Prior admitted that he *had* heard it." The deacon also was extremely hazy on the incident. Fortunately on the shelves were several volumes of the "Epistles of the Apostles" in a somewhat unused condition, and by their aid, and the inducement of our author, the deacon read the shipwreck story to the brothers and servitors, to their delight and information.

Mr. Trevor-Battye narrates an instance of a well known protective resemblance which he observed at Furnés. He had been collecting seed of a shrub in which the seed-capsules are thickly grouped above the nodes of the branches. His boy brought him one having apparently a double set of seed. "As soon as I had it in my hand, I noticed that the lower set was not composed of seeds at all, but entirely of little snail-shells, so closely imitative of the seeds that they might quite easily deceive any snail-eating bird." The shrub is known as *Vitex agnus-castus*.

